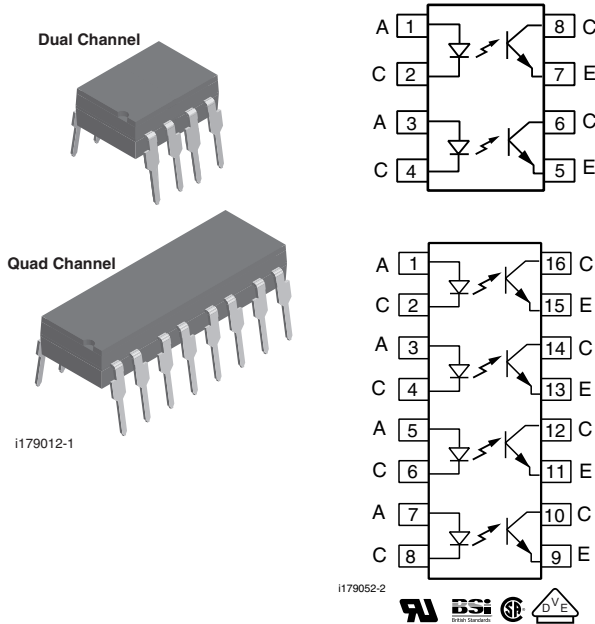


## Optocoupler, Phototransistor Output (Dual, Quad Channel)



### FEATURES

- Identical channel to channel footprint
- Dual and quad packages feature:
  - Reduced board space
  - Lower pin and parts count
  - Better channel to channel CTR match
  - Improved common mode rejection
- Isolation test voltage from double molded package, 5300 V<sub>RMS</sub>
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC


**RoHS**  
COMPLIANT

### AGENCY APPROVALS

- UL1577, file no. E52744 system code H, double protection
- CSA 93751
- BSI IEC 60950; IEC 60065
- DIN EN 60747-5-2 (VDE0884)/DIN EN 60747-5-5 pending, available with option 1

### DESCRIPTION

The ILD615, ILQ615 are multi-channel phototransistor optocouplers that use GaAs IRLED emitters and high gain NPN phototransistors. These devices are constructed using over/under leadframe optical coupling and double molded insulation technology resulting a withstand test voltage of 7500 V<sub>ACPEAK</sub> and a working voltage of 1700 V<sub>RMS</sub>.

The binned min./max. and linear CTR characteristics make these devices well suited for DC or AC voltage detection. Eliminating the phototransistor base connection provides added electrical noise immunity from the transients found in many industrial control environments.

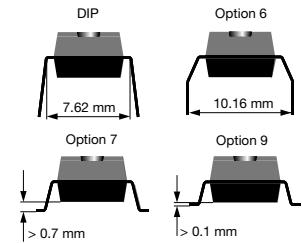
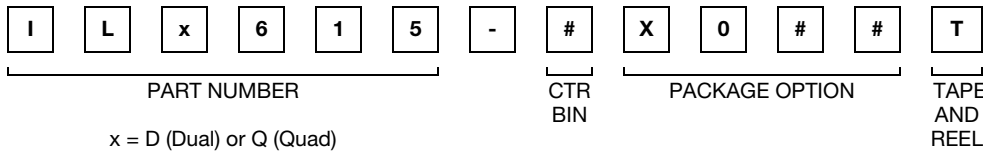
Because of guaranteed maximum non-saturated and saturated switching characteristics, the ILD615, ILQ615 can be used in medium speed data I/O and control systems. The binned min./max. CTR specification allow easy worst case interface calculations for both level detection and switching applications. Interfacing with a CMOS logic is enhanced by the guaranteed CTR at I<sub>F</sub> = 1 mA.

# ILD615, ILQ615



Vishay Semiconductors Optocoupler, Phototransistor Output  
(Dual, Quad Channel)

## ORDERING INFORMATION



AGENCY CERTIFIED/PACKAGE	DUAL CHANNEL				QUAD CHANNEL			
	CTR (%)							
	10 mA							
UL, CSA, BSI, VDE	40 to 80	63 to 125	100 to 200	160 to 320	40 to 80	63 to 125	100 to 200	160 to 320
DIP-8	ILD615-1	ILD615-2	ILD615-3	ILD615-4	-	-	-	-
DIP-8, 400 mil, option 6	-	-	-	ILD615-4X006	-	-	-	-
SMD-8, option 7	ILD615-1X007T	-	-	-	-	-	-	-
SMD-8, option 9	ILD615-1X009	ILD615-2X009T <sup>(1)</sup>	ILD615-3X009T	ILD615-4X009T <sup>(1)</sup>	-	-	-	-
DIP-16	-	-	-	-	ILQ615-1	ILQ615-2	ILQ615-3	ILQ615-4
SMD-16, option 7	-	-	-	-	-	ILQ615-2X007	ILQ615-3X007T <sup>(1)</sup>	ILQ615-4X007
SMD-16, option 9	-	-	-	-	ILQ615-1X009	-	ILQ615-3X009T <sup>(1)</sup>	ILQ615-4X009T <sup>(1)</sup>
VDE	40 to 80	63 to 125	100 to 200	160 to 320	40 to 80	63 to 125	100 to 200	160 to 320
DIP-8	-	ILD615-2X001	-	ILD615-4X001	-	-	-	-
DIP-8, 400 mil, option 6	-	ILD615-2X016	ILD615-3X016	ILD615-4X016	-	-	-	-
SMD-8, option 7	-	-	ILD615-3X017T <sup>(1)</sup>	-	-	-	-	-
DIP-16	-	-	-	-	-	-	ILQ615-3X001	ILQ615-4X001
DIP-16, 400 mil, option 6	-	-	-	-	-	-	ILQ615-3X016	-
SMD-16, option 7	-	-	-	-	-	ILQ615-2X017	-	-

### Notes

- Also available in tubes; do not add T to end.
- Additional options may be possible, please contact sales office.

## ABSOLUTE MAXIMUM RATINGS (T<sub>amb</sub> = 25 °C, unless otherwise specified)

PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>INPUT</b>				
Reverse voltage		V <sub>R</sub>	6	V
Forward current		I <sub>F</sub>	60	mA
Surge current		I <sub>FSM</sub>	1.5	A
Power dissipation		P <sub>diss</sub>	100	mW
Derate linearly from 25 °C			1.33	mW/°C
<b>OUTPUT</b>				
Collector emitter breakdown voltage		BV <sub>CEO</sub>	70	V
Emitter collector breakdown voltage		BV <sub>ECO</sub>	7	V
Collector current		I <sub>C</sub>	50	mA
	t < 1 ms	I <sub>C</sub>	100	mA
Power dissipation		P <sub>diss</sub>	150	mW
Derate linearly from 25 °C			2	mW/°C



<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
<b>COUPLER</b>				
Storage temperature		$T_{stg}$	- 55 to + 150	$^{\circ}\text{C}$
Operating temperature		$T_{amb}$	- 55 to + 100	$^{\circ}\text{C}$
Junction temperature		$T_j$	100	$^{\circ}\text{C}$
Soldering temperature <sup>(1)</sup>	2 mm distance from case bottom	$T_{sld}$	260	$^{\circ}\text{C}$
Package power dissipation ILD615			400	mW
Derate linearly from 25 $^{\circ}\text{C}$			5.33	mW/ $^{\circ}\text{C}$
Package power dissipation ILQ615			500	mW
Derate linearly from 25 $^{\circ}\text{C}$			6.67	mW/ $^{\circ}\text{C}$
Isolation test voltage	$t = 1\text{ s}$	$V_{ISO}$	5300	$V_{RMS}$
Isolation voltage		$V_{IORM}$	890	$V_P$
Total power dissipation		$P_{tot}$	250	mW
Creepage distance			$\geq 7$	mm
Clearance distance			$\geq 7$	mm
Isolation resistance	$V_{IO} = 500\text{ V}, T_{amb} = 25\text{ }^{\circ}\text{C}$	$R_{IO}$	$\geq 10^{12}$	$\Omega$
	$V_{IO} = 500\text{ V}, T_{amb} = 100\text{ }^{\circ}\text{C}$	$R_{IO}$	$\geq 10^{11}$	$\Omega$

**Notes**

- Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this document. Exposure to absolute maximum ratings for extended periods of the time can adversely affect reliability.

<sup>(1)</sup> Refer to reflow profile for soldering conditions for surface mounted devices (SMD). Refer to wave profile for soldering conditions for through hole devices (DIP).

<b>ELECTRICAL CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>INPUT</b>						
Forward voltage	$I_F = 10\text{ mA}$	$V_F$	1	1.15	1.3	V
Breakdown voltage	$I_R = 10\text{ }\mu\text{A}$	$V_{BR}$	6	30		V
Reverse current	$V_R = 6\text{ V}$	$I_R$		0.01	10	$\mu\text{A}$
Capacitance	$V_R = 0\text{ V}, f = 1\text{ MHz}$	$C_O$		25		pF
Thermal resistance, junction to lead		$R_{THJL}$		750		K/W
<b>OUTPUT</b>						
Collector emitter capacitance	$V_{CE} = 5\text{ V}, f = 1\text{ MHz}$	$C_{CE}$		6.8		pF
Collector emitter leakage current, -1, -2	$V_{CE} = 10\text{ V}$	$I_{CEO}$		2	50	nA
Collector emitter leakage current, -3, -4	$V_{CE} = 10\text{ V}$	$I_{CEO}$		5	100	nA
Collector emitter breakdown voltage	$I_{CE} = 0.5\text{ mA}$	$BV_{CEO}$	70			V
Emitter collector breakdown voltage	$I_E = 0.1\text{ mA}$	$BV_{ECO}$	7			V
Thermal resistance, junction to lead		$R_{THJL}$		500		K/W
<b>PACKAGE TRANSFER CHARACTERISTICS</b>						
Channel/channel CTR match	$I_F = 10\text{ mA}, V_{CE} = 5\text{ V}$	CTR <sub>X</sub> /CTR <sub>Y</sub>	1 to 1		2 to 1	
<b>COUPLER</b>						
Capacitance (input to output)	$V_{IO} = 0\text{ V}, f = 1\text{ MHz}$	$C_{IO}$		0.8		pF
Insulation resistance	$V_{IO} = 500\text{ V}, T_A = 25\text{ }^{\circ}\text{C}$	$R_S$	$10^{12}$	$10^{14}$		$\Omega$
Channel to channel isolation			500			VAC

**Note**

- Minimum and maximum values are tested requirements. Typical values are characteristics of the device and are the result of engineering evaluations. Typical values are for information only and are not part of the testing requirements.

CURRENT TRANSFER RATIO ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
Current transfer ratio (collector emitter saturated)	$I_F = 10\text{ mA}$ , $V_{CE} = 0.4\text{ V}$	ILD615-1	$CTR_{CEsat}$		25		%
		ILQ615-1					
		ILD615-2	$CTR_{CEsat}$				
		ILQ615-2					
		ILD615-3	$CTR_{CEsat}$				
		ILQ615-3					
		ILD615-4	$CTR_{CEsat}$				
		ILQ615-4					
Current transfer ratio (collector emitter)	$I_F = 1\text{ mA}$ , $V_{CE} = 5\text{ V}$	ILD615-1	$CTR_{CE}$	13	30		%
		ILQ615-1					
		ILD615-2	$CTR_{CE}$				
		ILQ615-2					
		ILD615-3	$CTR_{CE}$				
		ILQ615-3					
		ILD615-4	$CTR_{CE}$				
		ILQ615-4					
	$I_F = 10\text{ mA}$ , $V_{CE} = 5\text{ V}$	ILD615-1	$CTR_{CE}$	40	60	80	%
		ILQ615-1					
		ILD615-2	$CTR_{CE}$				
		ILQ615-2					
		ILD615-3	$CTR_{CE}$				
		ILQ615-3					
ILD615-4	$CTR_{CE}$						
ILQ615-4							

SAFETY AND INSULATION RATED PARAMETERS						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Partial discharge test voltage - routine test	100 %, $t_{test} = 1\text{ s}$	$V_{pd}$	1.669			kV
Partial discharge test voltage - lot test (sample test)	$t_{Tr} = 60\text{ s}$ , $t_{test} = 10\text{ s}$ , (see figure 2)	$V_{IOTM}$	10			kV
		$V_{pd}$	1.424			kV
Insulation resistance	$V_{IO} = 500\text{ V}$	$R_{IO}$	$10^{12}$			$\Omega$
	$V_{IO} = 500\text{ V}$ , $T_{amb} = 100\text{ }^{\circ}\text{C}$	$R_{IO}$	$10^{11}$			$\Omega$
	$V_{IO} = 500\text{ V}$ , $T_{amb} = 175\text{ }^{\circ}\text{C}$ (construction test only)	$R_{IO}$	$10^9$			$\Omega$
Forward current		$I_{SI}$			275	mA
Power dissipation		$P_{SO}$			400	mW
Rated impulse voltage		$V_{IOTM}$			10	kV
Safety temperature		$T_{SI}$			175	$^{\circ}\text{C}$

**Note**

- According to DIN EN 60747-5-2 (see figure 2). This optocoupler is suitable for safe electrical isolation only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

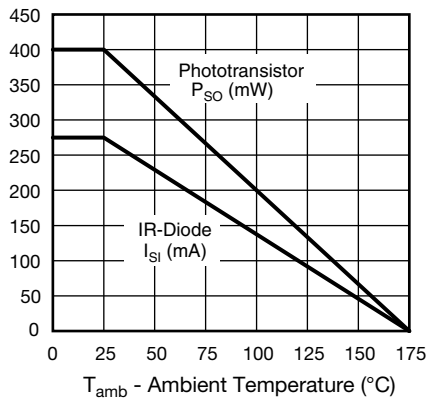
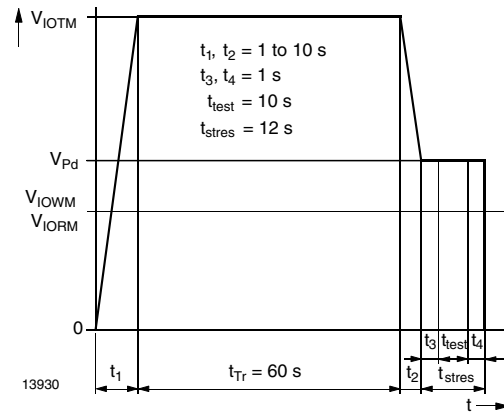


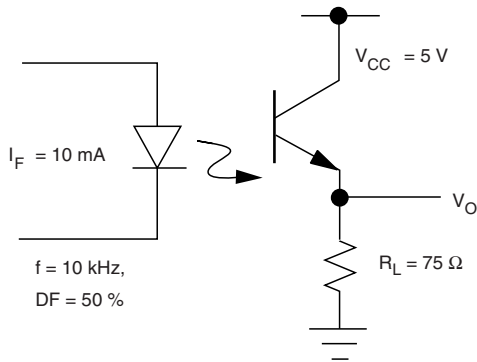
Fig. 1 - Derating Diagram


 Fig. 2 - Test Pulse Diagram for Sample Test according to  
 DIN EN 60747-5-2 (VDE0884); IEC60747-5-5

<b>SWITCHING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>NON-SATURATED</b>							
Current	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$I_F$		10		mA
Turn-on time	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$t_{on}$		3		$\mu\text{s}$
Rise time	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$t_r$		2		$\mu\text{s}$
Turn-off time	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$t_{off}$		2.3		$\mu\text{s}$
Fall time	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$t_f$		2		$\mu\text{s}$
Propagation H to L	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$t_{PHL}$		1.1		$\mu\text{s}$
Propagation L to H	$V_{CC} = 5\text{ V}$ , $R_L = 75\ \Omega$ , 50 % of $V_{PP}$		$t_{PLH}$		2.5		$\mu\text{s}$
<b>SATURATED</b>							
Current	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$I_F$		20		mA
		ILQ615-1					
		ILD615-2	$I_F$		10		mA
		ILQ615-2					
		ILD615-3	$I_F$		10		mA
		ILQ615-3					
ILD615-4	$I_F$		5		mA		
ILQ615-4							
Turn-on time	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$t_{on}$		3		$\mu\text{s}$
		ILQ615-1					
		ILD615-2	$t_{on}$		4.3		$\mu\text{s}$
		ILQ615-2					
		ILD615-3	$t_{on}$		4.3		$\mu\text{s}$
		ILQ615-3					
ILD615-4	$t_{on}$		6		$\mu\text{s}$		
ILQ615-4							

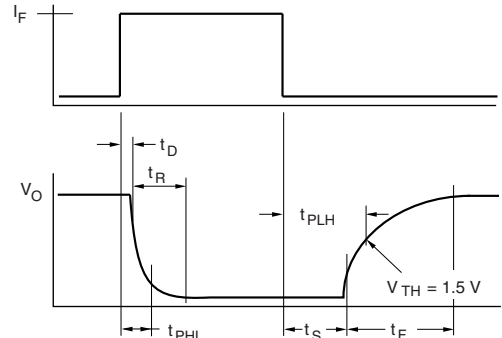
<b>SWITCHING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	PART	SYMBOL	MIN.	TYP.	MAX.	UNIT
<b>SATURATED</b>							
Rise time	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$t_r$		2		$\mu\text{s}$
		ILQ615-1					
		ILD615-2	$t_r$		2.8		$\mu\text{s}$
		ILQ615-2					
		ILD615-3	$t_r$		2.8		$\mu\text{s}$
		ILQ615-3					
ILD615-4	$t_r$		4.6		$\mu\text{s}$		
ILQ615-4							
Turn-off time	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$t_{off}$		18		$\mu\text{s}$
		ILQ615-1					
		ILD615-2	$t_{off}$		25		$\mu\text{s}$
		ILQ615-2					
		ILD615-3	$t_{off}$		25		$\mu\text{s}$
		ILQ615-3					
ILD615-4	$t_{off}$		25		$\mu\text{s}$		
ILQ615-4							
Fall time	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$t_f$		11		$\mu\text{s}$
		ILQ615-1					
		ILD615-2	$t_f$		14		$\mu\text{s}$
		ILQ615-2					
		ILD615-3	$t_f$		14		$\mu\text{s}$
		ILQ615-3					
ILD615-4	$t_f$		15		$\mu\text{s}$		
ILQ615-4							
Propagation H to L	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$t_{PHL}$		1.6		$\mu\text{s}$
		ILQ615-1					
		ILD615-2	$t_{PHL}$		2.6		$\mu\text{s}$
		ILQ615-2					
		ILD615-3	$t_{PHL}$		2.6		$\mu\text{s}$
		ILQ615-3					
ILD615-4	$t_{PHL}$		5.4		$\mu\text{s}$		
ILQ615-4							
Propagation L to H	$V_{CC} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $V_{TH} = 1.5\text{ V}$	ILD615-1	$t_{PLH}$		8.6		$\mu\text{s}$
		ILQ615-1					
		ILD615-2	$t_{PLH}$		7.2		$\mu\text{s}$
		ILQ615-2					
		ILD615-3	$t_{PLH}$		7.2		$\mu\text{s}$
		ILQ615-3					
ILD615-4	$t_{PLH}$		7.4		$\mu\text{s}$		
ILQ615-4							

<b>COMMON MODE TRANSIENT IMMUNITY</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)							
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT	
Common mode rejection output high	$V_{CM} = 50\text{ V}_{P-P}$ , $R_L = 1\text{ k}\Omega$ , $I_F = 0\text{ mA}$	$CM_H$		5000		$\text{V}/\mu\text{s}$	
Common mode rejection output low	$V_{CM} = 50\text{ V}_{P-P}$ , $R_L = 1\text{ k}\Omega$ , $I_F = 0\text{ mA}$	$CM_L$		5000		$\text{V}/\mu\text{s}$	
Common mode coupling capacitance		$C_{CM}$		0.01		$\text{pF}$	

**TYPICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)


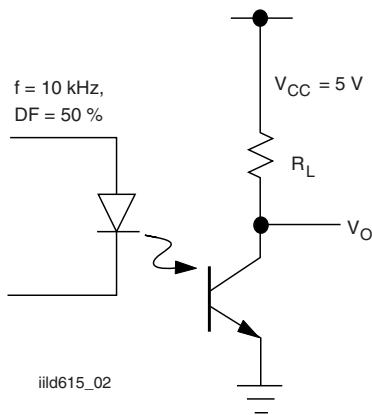
iild615\_01

Fig. 3 - Non-Saturated Switching Timing



iild615\_04

Fig. 6 - Saturated Switching Timing



iild615\_02

Fig. 4 - Saturated Switching Timing

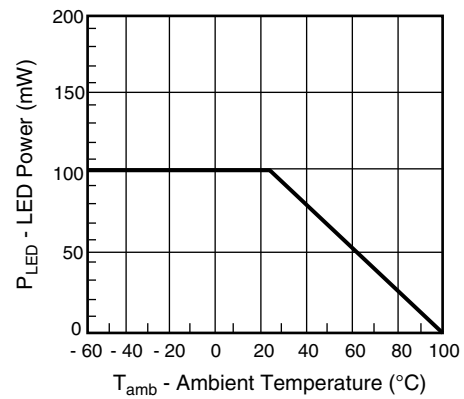
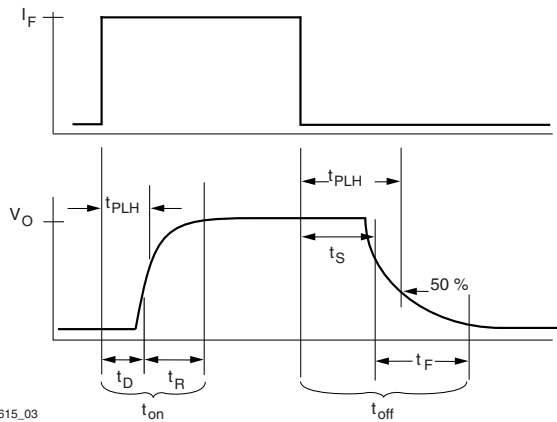
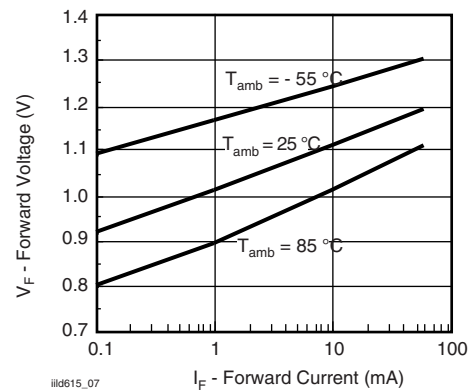


Fig. 7 - Maximum LED Power Dissipation



iild615\_03

Fig. 5 - Non-Saturated Switching Timing



iild615\_07

Fig. 8 - Forward Voltage vs. Forward Current

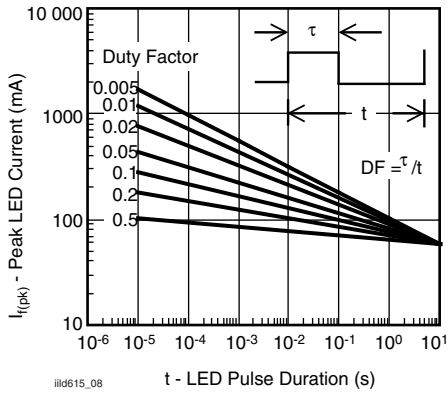


Fig. 9 - Peak LED Current vs. Pulse Duration,  $\tau$

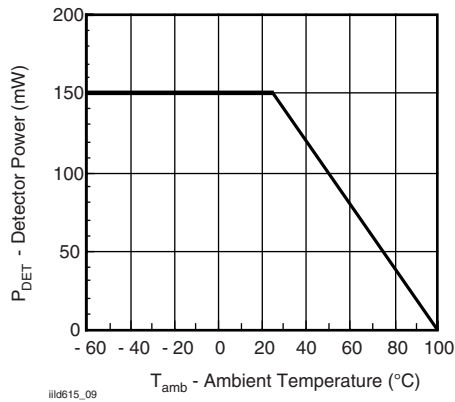


Fig. 10 - Maximum Detector Power Dissipation

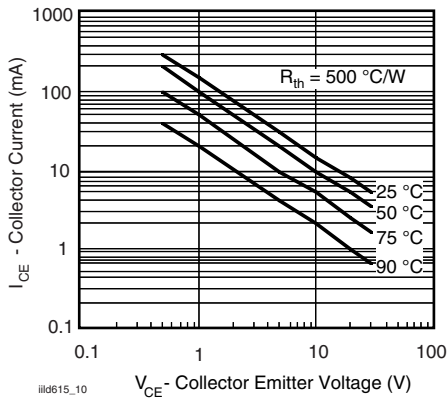


Fig. 11 - Maximum Collector Current vs. Collector Voltage

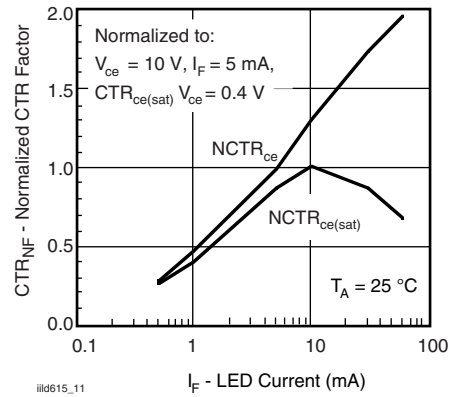


Fig. 12 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$

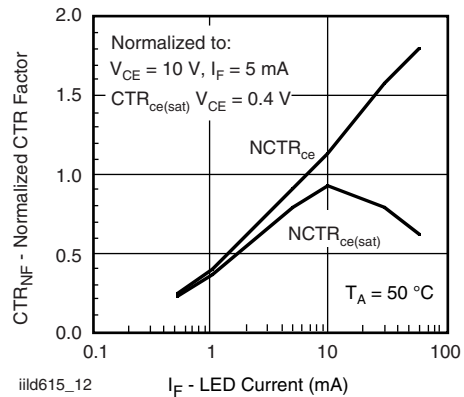


Fig. 13 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$

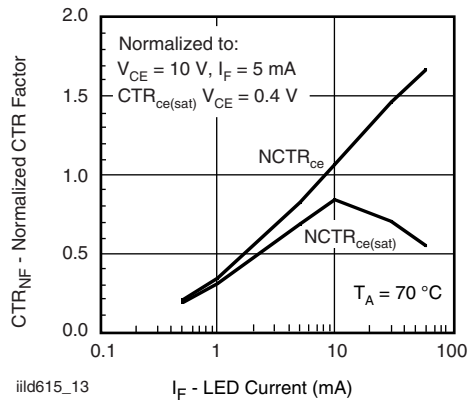


Fig. 14 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$



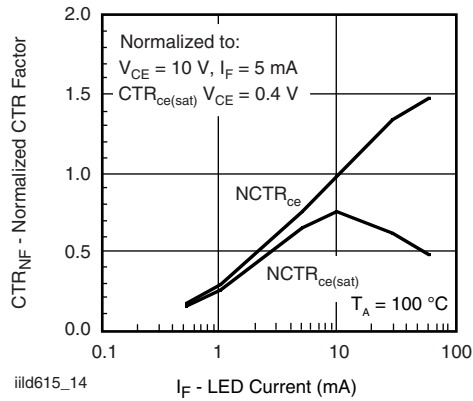


Fig. 15 - Normalization Factor for Non-Saturated and Saturated CTR vs.  $I_F$

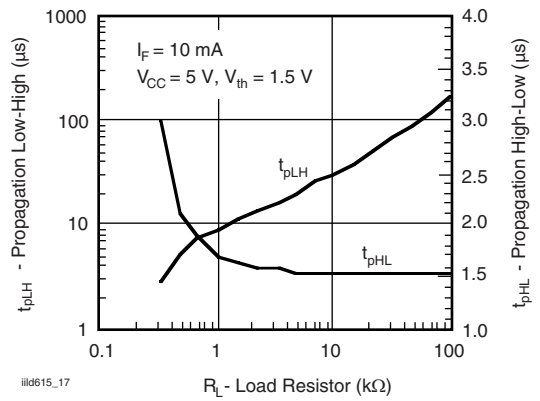


Fig. 18 - -1, Propagation Delay vs. Collector Load Resistor

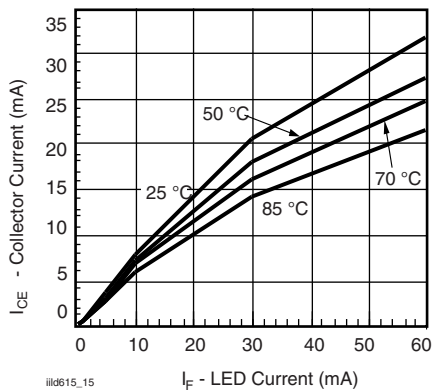


Fig. 16 - Collector Emitter Current vs. Temperature and LED Current

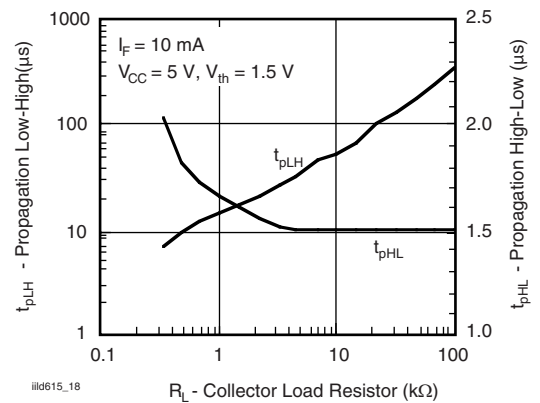


Fig. 19 - -2, -3, Propagation Delay vs. Collector Load Resistor

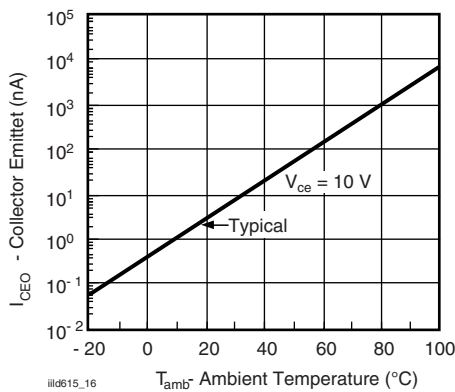


Fig. 17 - Collector Emitter Leakage vs. Temperature

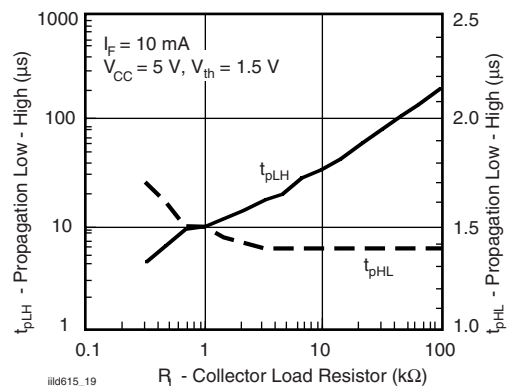


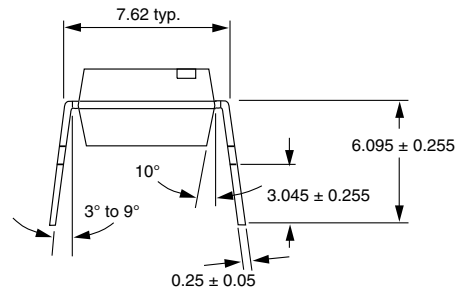
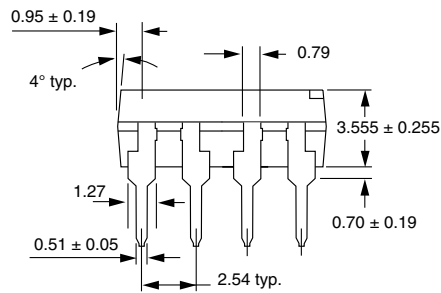
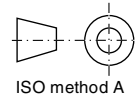
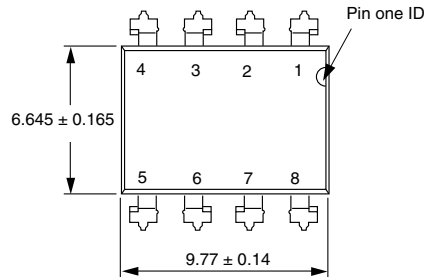
Fig. 20 - -4, Propagation Delay vs. Collector Load Resistor

# ILD615, ILQ615

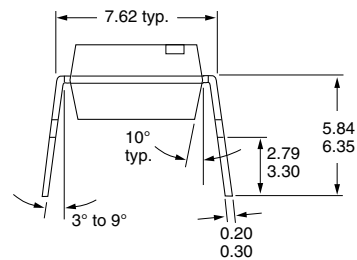
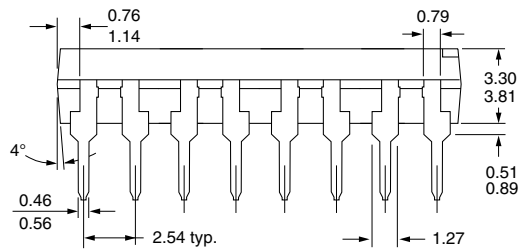
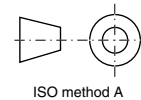
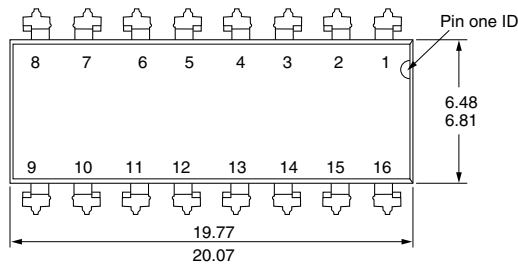


Vishay Semiconductors Optocoupler, Phototransistor Output  
(Dual, Quad Channel)

## PACKAGE DIMENSIONS in millimeters

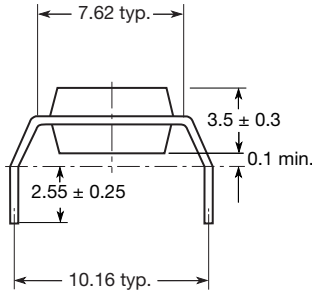


i178006

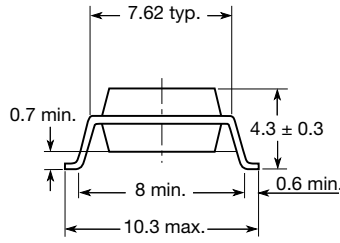


i178007

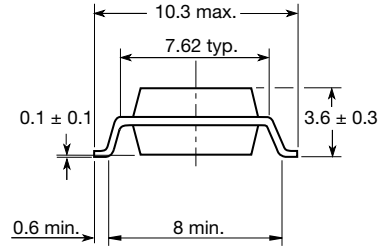
**Option 6**



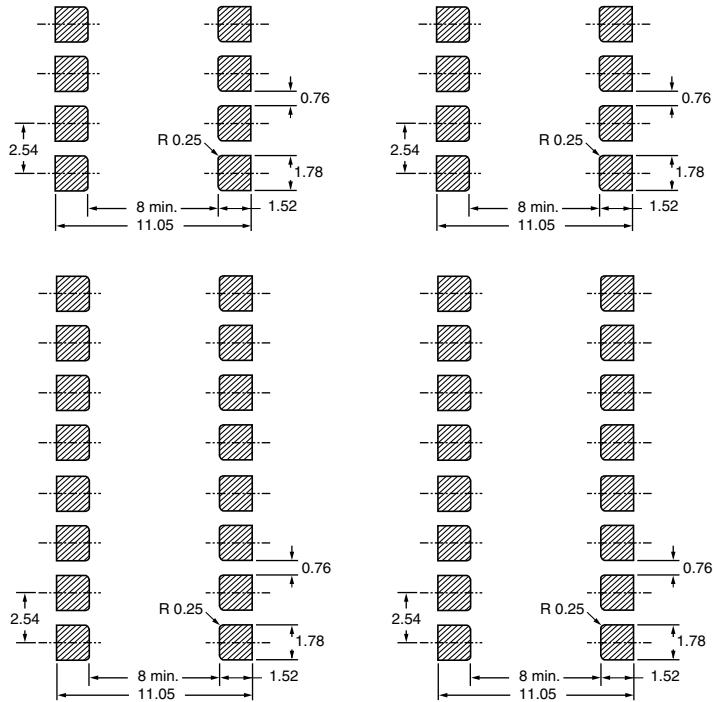
**Option 7**



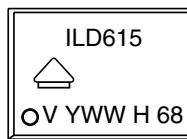
**Option 9**



20802-22



### PACKAGE MARKING



21764-88

### Notes

- Only options 1 and 7 reflected in the package marking.
- The VDE Logo is only marked on option1 parts.
- Tape and reel suffix (T) is not part of the package marking.



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